

LETTERS TO THE EDITOR.

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Radio-active Gas in Mineral Springs.

IN a letter to NATURE of August 13, 1903, it was announced that experiments carried out at the Blythswood Laboratory had shown the presence of a radio-active constituent in the gases derived from the mineral waters of Bath. An account of our further investigations has been given in a paper read before the Royal Philosophical Society of Glasgow, November 18, 1903. Samples of water from the Buxton springs have been tested with results exactly similar in character to those given by Bath waters. In both cases the ionisation-current through the gas obtained from the water increased to a maximum in about one hour from the commencement of an experiment, and then diminished to the normal value. In a note added to this paper, December 15, 1903, an experiment is described similar to one carried out by Mr. E. P. Adams (*Phil. Mag.*, vol. vi. p. 563, 1903). A current of air was drawn through a very dilute solution of a radium salt, and then through a Winchester quart containing distilled water. The air current was continued for two hours. The distilled water after this treatment was tested in exactly the same manner as the Bath water, "the results being in all respects similar. . . . It is therefore probable that the radio-activity of these (mineral) waters is due to the presence of radium near their source."

This anticipation has been confirmed by the Hon. R. J. Strutt's discovery of radium in the iron deposits left by the hot springs of Bath.

We have recently obtained conclusive evidence of the presence of radium emanation in the Buxton springs through the kindness of Mr. J. W. Wardley, who has collected samples of the gases that rise through the water and forwarded them to us for examination. In our former experiments with water sent from the springs the amount of gas obtained was extremely small, and the consequent activity inconsiderable. We now find that the activity of the gas falls to half value in about three and a half days, the corresponding time for the radium emanation being 3.71 days (Rutherford).

It would be interesting to know whether treatment by the gases obtained from the springs possesses any therapeutic value.

BLYTHSWOOD.
H. S. ALLEN.

Blythswood Laboratory, Renfrew.

Projection of Imitation Spinhariscope Appearance.

In thinking over how to exhibit to an audience the appearance of a zinc-sulphide screen bombarded by radium, one of my sons suggested that a kinematograph film often imitated the effect, by reason of its punctures being thrown on the screen by intermittent light. Accordingly he made a model with two numerous punctured plates mounted on eccentrics so as to slide over one another in a periodic fashion. It is sufficient, however, to hold two punctured plates by hand in the place of a lantern slide, and move them irregularly over each other slowly.

OLIVER LODGE.

American Tropical Laboratory.

THE Director of Kew presents his compliments to the Editor of NATURE and requests the publication of the enclosed letter.

Kew, January 8.

New York Botanical Garden,
Bronx Park, New York City,
December 26, 1903.

My dear Sir William,

Referring to my letter of August 14, 1903, I take pleasure in stating that the group of buildings of the Colonial Government of Jamaica at the Cinchona Botanical Garden

will be maintained as a botanical laboratory by the New York Botanical Garden under an agreement with the Colonial Government, and with the cooperation of the Department of Public Gardens and Plantations of Jamaica; sufficient land for experimental purposes and for a nursery is included in the leasehold privileges. The buildings include a residence known as Bellevue House, three laboratories, two ranges of glass, and one or two small buildings suitable for lodgings.

Investigators are offered the following facilities:—

- (1) The use of tables in the laboratory buildings.
- (2) Lodging in Bellevue House or in one of the other buildings at Cinchona.
- (3) The use of land for experimental purposes.
- (4) Privileges to study the plantations at Cinchona, and also those at Hope and Castleton Gardens.
- (5) Privilege to consult the botanical library of the Department of Public Gardens and Plantations at Hope Gardens, and to take books therefrom to Cinchona under such conditions as may be imposed by the Director of Public Gardens and Plantations.
- (6) An immense number of indigenous species are within easy reach in the primitive forests adjacent to Cinchona.

All persons who may apply for permission to study at Cinchona must submit such evidence as the Director-in-Chief of the New York Botanical Garden may require that they are competent to pursue investigation to advantage. While in residence at Cinchona they will be under the supervision of the Hon. William Fawcett, Director of Public Gardens and Plantations, to whose interest and advice the establishment of this American tropical laboratory is largely due.

A laboratory fee, payable to the New York Botanical Garden, will be required of persons granted the above privileges.

Upon approval by the scientific directors of the New York Botanical Garden, any other institution, society or individual may be assigned the use of a table at Cinchona by the payment of one hundred dollars annually, which will entitle them to nominate students desiring to avail themselves of the facilities of the laboratory for admission without the payment of fees, but not more than one person may be granted the use of any table at the same time.

The necessary expenses for a month's residence at Cinchona, including travelling expenses to and from ports on the Atlantic seaboard of the United States, are from 140 dollars to 200 dollars; for two months' residence 160 dollars to 230 dollars.

Dr. MacDougal will be glad to give you any further information concerning this subject that you may care for, and we hope that you or some of your students may be able to utilise the resources of the laboratory from time to time.

Yours sincerely,

(Signed) N. L. BRITTON,
Director-in-Chief.

Escape of Gases from Atmospheres.

In the Literary Supplement of the *Times* of December 25, 1903, an erroneous statement is on p. 375 placed before its readers, to the effect that our alleged knowledge of the escape of some gases from the atmospheres of planets and satellites is based on an assumed absence of helium from the earth's atmosphere, and has been disposed of by the discovery that helium is present. A brief letter was addressed to the editor of the *Times* giving proofs that the above statement is incorrect, and from this letter an extract has been published as a note in the next number of the Literary Supplement. The matter concerns one of the great cosmical agencies of nature, and I therefore request you to allow me to deal with the subject in the more adequate way which is permissible when addressing a scientific journal.

The problem of the escape of gases from atmospheres has been approached in two ways, both of which the present writer has tried, and one of them has also of recent years been attempted by other scientific men:—(1) The problem has been treated deductively by ascertaining the law of the distribution of speeds among the particles of a hypothetical kinetic system, so constructed as to be a model of gas simple enough for human mathematics to enable us to compute the distribution of speeds within it, and which it was hoped

would sufficiently represent what goes on in the actual gases with which we have to deal. This expectation, unfortunately, has not yet been fulfilled (see *Proceedings of the American Philosophical Society*, vol. xlii. p. 108). (2) The problem has been treated inductively by arguing upwards from known facts of nature. It is in reference to this second method that the *Times* makes its statement.

So far from its being true, as was supposed by the *Times*, that the argument is based on the assumption that there is no helium in our atmosphere, it is pointed out in the first memoir upon the subject that there must be just such traces of helium and hydrogen in our atmosphere as have since been detected (see *Scientific Transactions of the Royal Dublin Society*, vol. vi. pp. 308 and 309).

The facts of nature which were made the data of the investigation are four in number. The first of these is *that there is either no atmosphere or very little on the moon*, from which it is inferred that the atmosphere which the moon shared with the earth when the two bodies separated, and whatever atmospheric gases have since been evolved upon the moon, have by this time escaped. It can be shown that if this be so, then hydrogen, if uncombined, must be able to escape from the earth. There is, however, but little free hydrogen upon the earth, and in the atmosphere there is only the merest trace. If there is in this trace any excess over what returns to the earth in rain or in other ways, this excess is on its way upwards towards the penultimate stratum of the atmosphere, which is the part of the atmosphere from which gases escape. Accordingly, the amount of hydrogen which succeeds in getting away from the earth must be very small, while the store of hydrogen locked up in the ocean and in the solid earth is enormous. It can, moreover, be shown that there is a minute accession of hydrogen to the earth from outside, so that on the whole the quantity of hydrogen upon the earth may be almost stationary.

The second and third facts used as data are that helium and free hydrogen are being continuously supplied from the earth to its atmosphere, and that—probably in both cases, certainly in the case of helium—only a very small percentage of the gross supply is being washed down by rain or in other ways returned to the earth, notwithstanding which *neither the hydrogen nor the helium has gone on accumulating in the atmosphere*. From this it is inferred that the quantity which is present in the atmosphere has adjusted itself to be such that the outflow of these gases from the upper regions of the atmosphere balances the net supply which the atmosphere receives from below.

One other fact in nature is used as a datum—that the earth's potential of gravitation is sufficient to prevent any sensible escape of the lightest of the abundant constituents of its atmosphere. This lightest abundant constituent is the vapour of water.

A further paper has been published which is devoted specially to dealing with the behaviour of helium in the earth's atmosphere (see *Astrophysical Journal*, vol. xi. p. 369). In this paper it is shown from the marvellously accurate determinations made by Sir William Ramsay and his assistants that the supply of helium to the atmosphere by hot springs, and presumably the helium which oozes up elsewhere through the soil, is from 3000 to 6000 times more than can be accounted for as being a return to the atmosphere of helium which had been washed down by rain; whereas the argon, oxygen and nitrogen in such springs are all of them present in proportions which are consistent with their having been carried down by rain from the atmosphere. From which it is inferred (1) that nearly the whole of the small quantity of helium in the atmosphere is on its way outwards; (2) that helium would have become a larger constituent of the atmosphere by reason of the influx from below if there had been no simultaneous outflow from above; (3) that the rate of this outflow is presumably equal to the net rate of supply.

The escape of helium from a member of the solar system must be facilitated by the circumstances that those radiations from the sun that can affect helium have the full strength of radiation from the photosphere, inasmuch as the helium in the sun's outer atmosphere emits radiations of the same intensity as the photosphere. This is evidenced by the great helium line D_3 being as bright as the neigh-

bouring part of the spectrum of the photosphere. We have, moreover, to take into account that outpour of corpuscles from the sun which, in the upper regions of our atmosphere, is able to excite into intense activity the internal motions of krypton which produce the green auroral line, and presumably with equal and perhaps increased vigour imparts energy to the molecules of helium which range to still greater altitudes.

G. JOHNSTONE STONEY.

30 Ledbury Road, W., January 7.

On the Origin of Spiral Nebulas.

THE ever increasing interest and importance of studies relating to celestial phenomena naturally lead up to questions which, in the present state of our knowledge, can (from the purely theoretical standpoint) in some cases be answered in a fairly satisfactory way.

The object of this note is to present certain views (some of which are believed to be new) on the probable origin of spiral nebulae, having given to start with an incandescent body like our sun.

From theory and observation we know that when different parts of the same fluid body have largely different temperatures the mass is in unstable equilibrium. The constant tendency of the resulting flow of the fluid is to equalise the temperature throughout the mass.

If the maximum temperature is in the interior of the body and the outside is exposed to a much lower temperature, the flow near the surface, through a gradual congealing of the latter, will be retarded. Such a surface will then also act as an insulator and shield to prevent both the too rapid loss of internal heat and the free escape of the accompanying gases.

The visible photosphere of the sun is known to be in a highly heated condition, and the fact that it is almost constantly being ruptured (in some zones more strongly and frequently than in others) shows—reasoning from analogy—that the solar surface has the properties of a fluid in such a state of unstable equilibrium that the superheated confined masses in the interior are still able to break through this surface at many points.

If the sun did not rotate on an axis, this surface would probably be of uniform strength throughout, for the interior circulation would then be radial. The resultant, however, of the rotary and radial forces acting on each particle produces not only an ellipsoidal figure, but also has the tendency to cause each ascending particle to move towards the equator.

As a result there is a tendency to produce surface-flow towards the equator causing an accumulation of cooled matter along the zone which but for this flow would be the weakest part of the whole rotating surface. It is therefore to be expected that two zones of least strength should exist in the solar surface, symmetrically situated with reference to the equator, but at some distance from it.

Now what is most likely to happen after a body like the sun has contracted to such a radius that the surface exists in the plastic or semi-solid state?

Such a surface will act as an insulator producing a more nearly uniform internal temperature and a consequent decrease in the interior circulation. The surface flow having ceased, and the axial velocity of rotation having increased, the zone of least surface-strength will coincide with the equator.

During the time required to reach this stage of the body's history it is probable that the lesser vents were gradually closed as the surface became stronger, resulting in periodic outbursts of increasing magnitude at a smaller number of openings until finally these also were closed.

As the weight of each particle of matter in the surface has increased inversely as the square of the radius (the sun's radius being unity), the internal pressure has been increased. Through the continued contraction of the outer surface this pressure, no longer relieved by periodic outbursts, increases far beyond the limit necessary to support the surface; as a result, the outer boundary grows hotter and consequently weaker, so that at last a great rupture of the surface takes place on or near the equator.

The moment this break occurs, the interior masses and